**SCH3U – Gases and Atmospheric Chemistry**

**Long-term (Unit) Learning Goals**

By the end of this unit, we will be able to

* analyse some effects of human activities and technologies on air quality
* describe some Canadian initiatives to reduce air pollution and one’s own carbon footprint
* investigate gas laws that explain the behaviour of gases
* solve problems related to gas laws
* demonstrate an understanding of gas laws
* explain the behaviour of gases

**Lesson 1 (1 or 2 days)**

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| **Curriculum Expectations:**  F1.1 analyse the effects on air quality of some technologies and human activities (e.g., smelting; driving gas-powered vehicles), including their own activities, and propose actions to reduce their personal carbon footprint [AI, C]  F1.2 assess air quality conditions for a given Canadian location, using Environment Canada’s Air Quality Health Index, and report on some Canadian initiatives to improve air quality and greenhouse gases (e.g., Ontario’s Drive Clean program to control vehicle emissions) [AI, C]  F3.1 Identify the major and minor chemical components of Earth’s atmosphere  A1.9 analyse the information gathered from  research sources for logic, accuracy, reliability,  adequacy, and bias  A1.10 draw conclusions based on inquiry results  and research findings, and justify their conclusions  with reference to scientific knowledge  A1.11 communicate ideas, plans, procedures,  results, and conclusions orally, in writing, and/or  in electronic presentations, using appropriate  language and a variety of formats (e.g., data  tables, laboratory reports, presentations, debates,  simulations, models) | **Learning Goals:**  We will be able to...   * analyse some effects of human activities, including our own, and technologies on air quality * propose actions to reduce our carbon footprint * assess air quality conditions for Mississauga using Environment Canada’s Air Quality Health Index * report on some Canadian initiatives to improve air quality and greenhouse gases * identify the major and minor chemical components of Earth’s atmosphere |
| **Success Criteria:**   * gathers information from reliable sources * uses information to help analyse effects on air quality, propose actions to reduce our carbon footprint, and report on some Canadian initiatives * accurately uses the Air Quality Health Index to assess air quality conditions * correctly identifies the major and minor chemical components of Earth’s atmosphere * communicates ideas in a format of choice (report, poster, etc.) | |

**Lesson 2 (2 days)**

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| **Curriculum Expectations:**  F2.1 use appropriate terminology related to gases  and atmospheric chemistry, including, but not  limited to: *standard temperature, standard pressure, molar volume,* and *ideal gas* [C]  F2.2 determine, through inquiry, the quantitative  and graphical relationships between the pressure,  volume, and temperature of a gas [PR, AI]  F3.5 explain Dalton’s law of partial pressures,  Boyle’s law, Charles’s law, Gay-Lussac’s law,  the combined gas law, and the ideal gas law  A1.5 conduct inquiries, controlling relevant  variables, adapting or extending procedures as  required, and using appropriate materials and  equipment safely, accurately, and effectively, to  collect observations and data  A1.6 compile accurate data from laboratory and  other sources, and organize and record the data,  using appropriate formats, including tables, flow  charts, graphs, and/or diagrams  A1.8 synthesize, analyse, interpret, and evaluate  qualitative and quantitative data; solve problems  involving quantitative data; determine  whether the evidence supports or refutes the  initial prediction or hypothesis and whether it is  consistent with scientific theory; identify sources  of bias and error; and suggest improvements  to the inquiry to reduce the likelihood of error  A1.10 draw conclusions based on inquiry results  and research findings, and justify their conclusions  with reference to scientific knowledge | **Learning Goals:**  We will be able to...   * plan and conduct an experiment that explores the behaviour of a gas * explain Boyle’s law, Charles’s law and Gay-Lussac’s law |
| **Success Criteria:**   * conduct inquiries using appropriate materials and equipment safely, accurately, and effectively * control relevant variables * identify an appropriate independent and dependent variable * collect observations and data * organize data in appropriate table format * organize data in appropriate graph format * analyze table and/or graph to find a relationship (e.g., between pressure, temperature, and volume of a gas) * draw and justify a conclusion based on data * state Boyle’s law, Charles’ law, and Gay-Lussac’s law using appropriate terminology and based on the analysis of inquiries | |

**Lesson 3 (1 or 2 days)**

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| **Curriculum Expectations:**  F2.3 solve quantitative problems by performing  calculations based on Boyle’s law, Charles’s  law, Gay-Lussac’s law, the combined gas law,  Dalton’s law of partial pressures, and the ideal  gas law [AI]– not ideal gas law or partial pressures  F3.2 describe the different states of matter, and  explain their differences in terms of the forces  between atoms, molecules, and ions  F3.3 use the kinetic molecular theory to explain  the properties and behaviour of gases in terms  of types and degrees of molecular motion  A1.8 synthesize, analyse, interpret, and evaluate  qualitative and quantitative data; solve problems  involving quantitative data; determine  whether the evidence supports or refutes the  initial prediction or hypothesis and whether it is  consistent with scientific theory; identify sources  of bias and error; and suggest improvements  to the inquiry to reduce the likelihood of error  A1.12 use appropriate numeric, symbolic, and  graphic modes of representation, and appropriate  units of measurement (e.g., SI and imperial units)  A1.13 express the results of any calculations  involving data accurately and precisely, to the appropriate number of decimal places or significant figures | **Learning Goals:**  We will be able to...   * explain the different states of matter based on forces between atoms, molecules, and ions * explain properties and behaviour of gases using the kinetic molecular theory * solve problems based on Boyle’s law, Charles’s law, Gay-Lussac’s law, and the combined gas law |
| **Success Criteria:**   * correctly explains the different states of matter based on forces between atoms, molecules, and ions * correctly explains properties and behaviour of gases using the kinetic molecular theory * identifies a problem as corresponding to Boyle’s law, Charles’s law, Gay-Lussac’s law or the combined gas law * uses an appropriate strategy to solve problems involving gas laws * uses appropriate SI units and significant digits | |

**Lesson 4 (1 day)**

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| **Curriculum Expectations:**  F2.3 solve quantitative problems by performing  calculations based on Boyle’s law, Charles’s  law, Gay-Lussac’s law, the combined gas law,  Dalton’s law of partial pressures, and the ideal  gas law [AI] – ideal gas law  F3.4 describe, for an ideal gas, the quantitative  relationships that exist between the variables of  pressure, volume, temperature, and amount  of substance  F3.5 explain Dalton’s law of partial pressures,  Boyle’s law, Charles’s law, Gay-Lussac’s law,  the combined gas law, and the ideal gas law  F3.6 explain Avogadro’s hypothesis and how his  contribution to the gas laws has increased our  understanding of the chemical reactions of gases  A1.8 synthesize, analyse, interpret, and evaluate  qualitative and quantitative data; solve problems  involving quantitative data; determine  whether the evidence supports or refutes the  initial prediction or hypothesis and whether it is  consistent with scientific theory; identify sources  of bias and error; and suggest improvements  to the inquiry to reduce the likelihood of error  A1.12 use appropriate numeric, symbolic, and  graphic modes of representation, and appropriate  units of measurement (e.g., SI and imperial units)  A1.13 express the results of any calculations  involving data accurately and precisely, to the appropriate number of decimal places or significant figures | **Learning Goals:**  We will be able to...   * analyse and explain Avogadro’s hypothesis and its contribution to the gas laws * develop the ideal gas law * solve problems using the ideal gas law |
| **Success Criteria:**   * identifies a problem as corresponding to the ideal gas law * uses an appropriate strategy to solve problems involving the ideal gas law * uses appropriate SI units and significant digits | |

**Lesson 5 (1 day)**

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| **Curriculum Expectations:**  F2.3 solve quantitative problems by performing  calculations based on Boyle’s law, Charles’s  law, Gay-Lussac’s law, the combined gas law,  Dalton’s law of partial pressures, and the ideal  gas law [AI] – partial pressures  F2.4 use stoichiometry to solve problems related to chemical reactions involving gases (e.g., problems involving moles, number of atoms, number of molecules, mass, and volume) [AI]  F3.5 explain Dalton’s law of partial pressures,  Boyle’s law, Charles’s law, Gay-Lussac’s law,  the combined gas law, and the ideal gas law  A1.8 synthesize, analyse, interpret, and evaluate  qualitative and quantitative data; solve problems  involving quantitative data; determine  whether the evidence supports or refutes the  initial prediction or hypothesis and whether it is  consistent with scientific theory; identify sources  of bias and error; and suggest improvements  to the inquiry to reduce the likelihood of error  A1.12 use appropriate numeric, symbolic, and  graphic modes of representation, and appropriate  units of measurement (e.g., SI and imperial units)  A1.13 express the results of any calculations  involving data accurately and precisely, to the appropriate number of decimal places or significant figures | **Learning Goals:**  We will be able to...   * observe and explain Dalton’s law of partial pressures * solve problems based on Dalton’s law of partial pressures * solve stoichiometry problems related to chemical reactions involving gases |
| **Success Criteria:**   * identifies a problem as corresponding to Dalton’s law of partial pressures * uses an appropriate strategy to solve problems involving Dalton’s law of partial pressures * uses an appropriate strategy to solve stoichiometry problems * uses appropriate SI units and significant digits | |

**Assessment *for/as* Learning:**

* diagnostic/anticipation guide for lesson 1
* exit cards & traffic lights for most lessons (e.g. RERUN chart for labs, traffic lights for checking work on solving problems, etc.)
* quizzes
* descriptive feedback (oral, written, using checklists) on problem solving, scientific investigation skills, quizzes; include opportunities for peer- and self-assessment (using same checklists)
* review problems prior to unit test

**Summatives:**

* Performance Tasks:
  + Lab: F2.5 (to meet part of expectation F2 and A1) 🡪 observation & product
  + Blog/Conversation: F1 and A1
* Unit Test (expectation F3, part of F2) 🡪 product